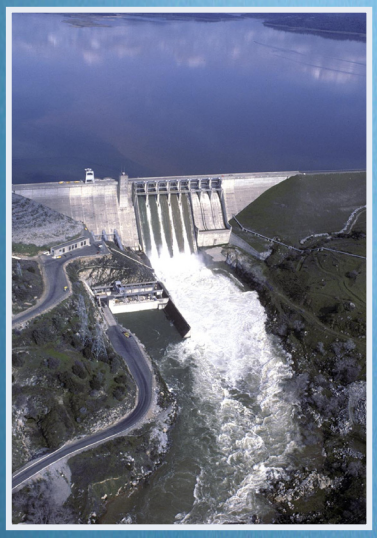
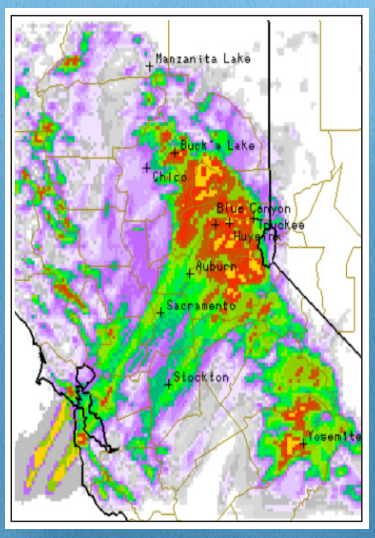
NOAA TESTBED *news*

SPRING 2010

LINKING RESEARCH & OPERATIONS TO IMPROVE WEATHER FORECASTS FOR THE NATION





HMT: Tackling the science of extreme precipitation & runoff to improve predictions...p. 4

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Cover Images: Background image by Paul Neiman; Folsom Dam above Sacramento, CA; ESRL/PSD Skywater scanning radar by David Kingsmill; Meteorological Tower at HMT field site in Talbot, CA by Clark King; Example of probabilistic quantitative precipitation forecast information from a high-resolution mesoscale model by John McGinley.

NOAA Testbed *news* is a publication from the NOAA USWRP Executive Committee
Bob Atlas, Don Berchoff, Al Powell, and Marty Ralph (Chair)

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Please send meeting notices, news story ideas, and suggestions to Janet.Intrieri@noaa.gov

http://www.uswrp.org

Greetings and welcome to the third issue of the NOAA Testbed News (NTN). Establishment of the NTN was a recommendation from the NOAA Testbed Workshop, which was held in April 2009 at NOAA's Earth System Research Laboratory (ESRL), in Boulder Colorado. Between these first three issues there have been dozens of contributed articles and highlights that have been distributed and viewed by hundreds of people in our field. Another recommendation was to reconvene the Workshop in 2010, which is happening from 4-5 May 2010 here in Boulder. A third recommendation was to prepare an article for the broader meteorological community on the emergence of Testbeds as a mechanism that fosters connections between "research" and "operations" in our field. Such an article is in preparation for submission to the Bulletin of the American Meteorological Society.

The common theme among these efforts is the sharing of experiences, including accomplishments, lessons learned, challenges and plans for the future. The Workshop and NTN also provide opportunities for those not currently involved in a Testbed to learn more about what they represent, how they work, and what their strengths and weaknesses are.

The agenda for the 2nd NOAA Testbed Workshop, for which over 70 people have registered, includes presentations from leaders in NOAA's planning for weather and water focused science and technology and leaders of the following existing testbeds: JHT, HMT, DTC, HWT, SPoRT, Climate Testbed, GOES-R Proving Ground, emerging Testbeds on Observing System Simulation Experiments and Operational Proving Ground, and on related activities, i.e., SIP, CSTAR, and THORPEX.

2nd NOAA Testbed Workshop Goals:

- Communicate results and future directions for individual testbeds and discuss broader cross-testbed issues and directions
- Identify best practices, collaborations and synergies that could be fostered across testbed efforts
- Understand and discuss improvements towards achieving our testbed goals
- Explore societal impact studies and linkages to testbed activities and goals

The NOAA U. S. Weather Research Program (USWRP) Executive Committee is the host of the May 2010 Testbed Workshop. Over the last several years, NOAA USWRP has helped launch individual testbeds that have now become self sustaining, and plans to continue seeding new Testbeds. This role is an outgrowth of the spirit of USWRP's efforts to bridge weather research and operations, and has been feasible within the scope of resources that have been available. Testbeds have not only become a linkage between science and services in weather, but have also become a focus of interagency collaborations and coordination. Initiating and sponsoring both the Testbed-focused Workshops and News, is another method by which NOAA USWRP is working to enhance connections between weather research and operations.

Finally, I'd like to thank especially Dr. Janet Intrieri and Barb DeLuisi for their efforts and professionalism in preparing the NTN, and remind readers that feedback on NTN is always welcome.

– Marty Ralph, NOAA USWRP Executive Committee, Chair

Meet Roger Pierce...

Roger Pierce became the acting director of NOAA's Office of Oceanic and Atmospheric Research (OAR), Office of Weather and Air Quality (OWAQ) in 2009 with the primary goal of program execution of the USWRP and NOAA portion of The Observing System Research and Predictability Experiment (THORPEX). In addition, the OWAQ functions as coordination entity in association with OAR headquarters and laboratories.

Roger is a familiar face to many across NOAA, as he has worked with OAR Laboratories and Cooperative Institutes for the past 8 years in OAR headquarters and has served in multiple detail assignments in NOAA headquarters, OAR Laboratories, the National Centers for Environmental Prediction, and in other leadership positions in OAR's Office of Policy, Planning, and Evaluation and former Office of Scientific Support. Before coming to OAR, Roger spent 17 years in the National Weather Service in multiple Hydrologist and Meteorologist positions in 3 regions and Headquarters. Roger possesses a B.S. degree in Physical Geography from Missouri State University, in Springfield, Missouri, and performed Graduate Studies in Meteorology and Hydrology at Northern Illinois University and the University of Hawaii.

You can contact Roger at Roger.Pierce@noaa.gov. He's located in Silver Spring, MD and his phone number is 301-734-1062.

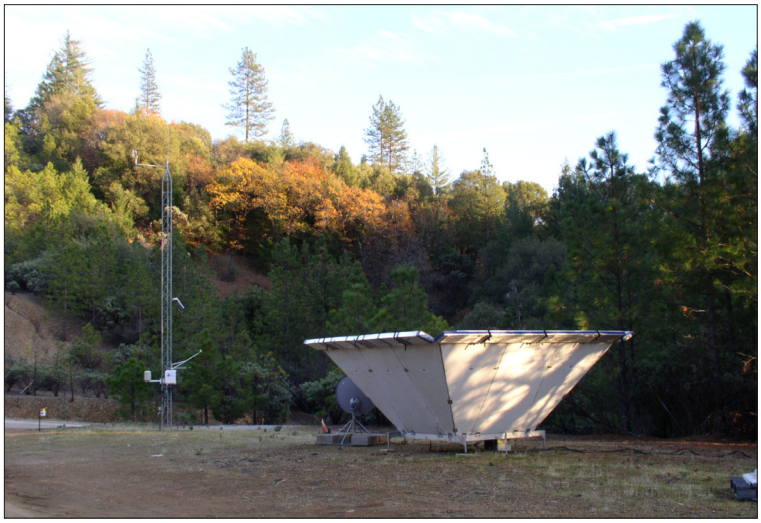
HMT: Science and technology innovations address west coast needs for extreme precipitation information in weather, climate and hydrology

They've been called the "Katrinas of the West"—atmospheric rivers of moisture-rich air can sweep up from the tropical Pacific and dump deadly winter storms on the West Coast of the United States. This past winter was the Hydrometeorology Testbed's (HMT's) sixth in California. HMT deploys customized instruments and develops advanced tools and methods to improve understanding of wintertime storms–and how they may be changing with climate change.

In the last several years, HMT scientists with the NOAA Earth System Research Laboratory (ESRL) Physical Sciences Division set up Atmospheric River Observatories on the California coast and further inland to track and study atmospheric rivers, which satellites can only follow over water. An atmospheric river combined with strong upward air motion could mean a storm capable of causing floods. "HMT is helping us figure out what it takes to understand high-impact weather events, both to save lives threatened in storms, and to understand what the future holds…" said HMT Project Manager, Tim Schneider.

During their studies in California, ESRL has developed strong relationships with state agencies, universities, and staff at several Weather Forecast Offices and two regional River Forecast Centers. These interactions have facilitated one major goal of HMT work: The transfer of promising experimental instrument and modeling systems into the hands of operational forecasters. "The knowledge HMT has given us is situational awareness," said Dave Reynolds, Meteorologist in Charge-NWS Monterey Forecast Office. "I can see what is coming, and I can prepare my customers—particularly emergency managers—for what is coming."

HMT goes beyond weather, too. ESRL scientists have been collecting observations and studying U.S. West Coast winter storms for more than a decade as part of a larger effort to understand the role of climate variability and change on coastal extreme events.



HMT field site in Colfax, CA, Credit: Clark King, NOAA

Although HMT-West has concentrated on California, researchers are confident that lessons learned there can be applied to the Pacific Northwest, where atmospheric rivers can also trigger major problems in wintertime. "We have the same phenomenon, but different geography," said Mr. Schneider.

Last year, the U.S. Army Corps of Engineers discovered leaks in Washington State's Howard Hanson Dam, which could turn disastrous should a large winter storm bring heavy precipitation to the region and stress the dam and downstream levees. The Army Corps needed better observations and forecasts until the dam can be repaired. Since ESRL had recently deployed a new Mobile Atmospheric River Monitoring System (MARMS) on the Washington Coast at Westport to study atmospheric rivers, they became involved in developing a plan to help monitor conditions near the dam. ESRL installed atmospheric river observing equipment at two nearby sites to measure wind, snow level, and water vapor. The National Weather Service set up 14 additional rain gauges near the dam. With data streaming in via the internet from the new equipment, NWS forecasters are able to monitor land-falling winter storm observations on the coast and compare them with conditions experienced closer to the dam. The data from this equipment is helping forecasters provide improved decision support services to the Army Corps and emergency managers.

ESRL's numerical modeling experts also play a critical role in HMT. Back in Boulder, Isidora Jankov, Steve Albers, and colleagues in the Global Systems Division gather together all available observations—from HMT's custom instrument suites to conventional meteorological data gathered in both California and Washington regions—and use it to fire up forecast models.

"See that blue? That's enhanced moisture flux moving toward the coast," Jankov said, pointing to her computer screen last month. "That's going to hit Seattle tomorrow, but today, it's hitting Vancouver. They're going to get some heavy rain."

The modelers are producing some of the longest-lead-time high-resolution forecasts ever for the California and Pacific Northwest regions, Jankov and Albers explain, and they are mixing-and-matching different physics, dynamics, and initialization schemes to create ensembles. (Model ensembles are widely recognized as able to produce more skillful forecasts than single, or "deterministic" model runs).

"We are using these ensembles for quantitative precipitation fore-

Howard Hanson Dam, Credit: USACE

casts and probabilistic quantitative precipitation forecasts," Jankov said. The runs rely on ESRL's supercomputing resources, and ensemble forecasts for HMT are run every six hours.

Jankov and Albers say they are working closely with the HMT team, including CalWater, River Forecast Centers, and the National Weather Service, to figure out what combinations of model components and ensemble methods will produce the best model-based precipitation forecasts. The researchers are especially interested in accurately forecasting when and where rain turns to snow, or vice versa. "This is very helpful information for the water managers who are predicting runoff," Albers said.

The still-experimental forecast systems may eventually become operational, he and Jankov said. "In a year or two, we will have something that stays in the Weather Forecast Offices, a legacy of HMT."

HMT will eventually establish other major regional efforts – focusing on the climatology and weather processes affecting extreme precipitation and flooding in other flood-prone parts of the nation. While committed to maintaining "legacy" activities in the West, the next focus region is the Southeast U.S. In addition to winter storms, the Southeast U.S. has its own complex set of problems when it comes to flooding: ice storms, heavy spring rains and the June-November hurricane season.

– Barb DeLuisi & Katy Human

For more information, visit: http://hmt.noaa.gov

Emerging science: Snow-level radar and HMT's CalWater legacy project

ESRL scientists have developed an inexpensive radar system that can detect and monitor snow level during winter storms. Because snow level can determine how much of a particular mountain basin will experience rain versus snow, it is an important predictor of snowpack levels and streamflow amount and timing- key data for water supply managers and for flood control.

ESRL's new snow-level radars have been installed at two sites in California, with seven more to follow in the next few years. With 18 other snow-level detecting radars deployed across the state this winter, these new systems will serve climate missions in the CalWater project and a legacy of the HMT-West project, the California Department of Water Resources EFREP (Enhanced Flood Response and Emergency Preparedness) program.

HMT's legacy project, which also involves other state-of-the-art monitoring equipment, modeling efforts and decision support tools, is intended to help California deal with the challenges of an aging water infrastructure, increased standards for urban flood protection, and the impacts of climate change.

The snow-level radars record cloud and precipitation information every 35 seconds, and report snow level every 10 minutes. These radars will help determine if there are long-term trends in snow level, and will assist forecasters in providing more accurate and timely forecasts of winter storms. Data from the radars, combined with CalWater measurements, will also provide critical data scientists need to improve regional climate models. Better modeling can help water managers prepare for California's future under climate change.

– Katy Human, NOAA/ESRL

Marty Ralph and Dave Costa look over a snow-level radar, Credit: Barb DeLuisi, NOAA

HWT Springs into Action

Collaboration with DTC Expands

NOAA's Hazardous Weather Testbed (HWT) develops, tests, and evaluates techniques designed to improve NWS severe weather forecasts and warnings. The HWT is jointly managed by NOAA's National Severe Storms Laboratory (NSSL), the NOAA/NWS Storm Prediction Center (SPC), and the NOAA/NWS Oklahoma City/Norman Weather Forecast Office (OUN), all located in the National Weather Center in Norman, Oklahoma. The HWT facilities include a combined forecast and research area placed between the operations areas of the SPC and OUN, and the NSSL Development Lab located nearby. Researchers, forecasters, and developers use these facilities to evaluate new scientific developments and forecast strategies, using data from both real-time operations and archived events. Collaboration among these diverse groups provides valuable feedback that can immediately be applied to the research and development process, streamlining science and technology transfer.

(c) Texas Tech University - Sarah Dillingham

The cornerstone of the testbed is the annual NOAA HWT Spring Experiment that attracts 50-60 researchers and forecasters to Norman each year. Forecasters are provided with a first-hand look at the latest research concepts and products, while research scientists are immersed in the challenges and needs of front-line forecasters. The close collaboration between research scientists and operational weather forecasters advances forecasts and warnings for hazardous weather events throughout the United States.

The 2010 HWT Spring Experiment projects are scheduled from April 12 through June 18, 2010, and will overlap the VORTEX-2 field campaign. Participants from the National Weather Service and other organizations will evaluate the operational utility of phased array radar technology, a dense radar network, experimental applications intended for GOES-R satellite, and multiple-radar/multiple sensor severe weather algorithms. All will work in real-time warning situations or with archived cases.

The Developmental Testbed Center (DTC), currently located jointly at NCAR Research Applications Laboratory (RAL) and NOAA Earth Systems Research Laboratory (ESRL), has a mission to perform extensive retrospective tests of new capabilities in the Weather Research and Forecasting (WRF) community model. Additionally, DTC, supports the addition of new capabilities to the WRF code base from the academic community through its visitor program. In essence, the DTC serves as a bridge between research and operations.

The collaboration between HWT and DTC for the HWT Experimental Forecast Program (EFP) Spring Experiment is a natural one. Every spring approximately 100 researchers and forecasters converge on the HWT to investigate the use of convection-allowing model forecasts as guidance for the prediction of severe convective weather. In addition to the severe convective weather component, this year's plan includes evaluation of forecasts from convection-allowing models for extreme precipitation events as well as aviation related thunderstorm indicators.

The DTC objective evaluation during the 2010 HWT Spring Experiment complements the subjective evaluation that has traditionally taken place. With the addition of probabilistic verification capabilities in the DTC's Model Evaluation Tool (MET), both probabilistic products and deterministic forecasts will be evaluated this year. It is anticipated that both the subjective and objective evaluations will support the use of latest scientific developments and forecast strategies by the SPC, NOAA/NWS, Hydrometeorological Predication Center (HPC) and NOAA/NWS Aviation Weather Center (AWC).

– Tara Jensen & Susan Cobb

Collaboration between NSSL and the local operational forecasting community dates back to the 1980s. After the Storm Prediction Center (SPC) moved its operations to the National Severe Storms Laboratory (NSSL) facility in 1997, the mutual interests of forecasters from the SPC, researchers from NSSL, and collocated joint research partners from the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS) inspired the formation of the current NOAA HWT. The testbed's activities have been varied, ranging from daily map discussions involving imminent severe weather to loosely-related research projects involving 2-3 collaborators to periodic intensive collaboration periods.

For more information, visit: http://www.vortex2.org/home/

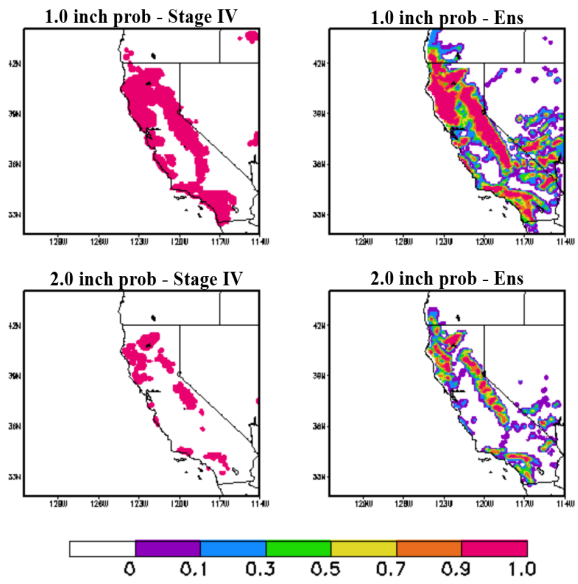
Did you know...

...that in 2009 NOAA's Office of Weather and Air Quality provided grants and awards to 12 Joint Hurricane Testbed PI's/institutions for a total of $2.1 Million and to 7 other PI's/institutions for a total of $1.9 Million for a combined total of $4 Million. You can see upcoming grant information, awards, deadlines, etc. at https://grantsonline.rdc.noaa.gov/flows/home/Login/LoginController.jpf. Note: A user ID and password will need to be requested and generated before you can access grants online.

DTC Launches Ensemble Testbed

As operational centers move towards ensemble-based probabilistic forecasting, the DTC has been asked to expand its efforts to provide a testbed platform to serve as a bridge between research and operations. Hence, the DTC has established the DTC Ensemble Testbed (DET). The goal of DET is to provide an environment in which extensive testing and evaluation of ensemble-related techniques can be conducted such that the results are immediately relevant to the operational centers (e.g. NCEP/EMC and AFWA). Community codes already supported by the DTC will serve as building blocks for the end-to-end ensemble testing and evaluation system to be assembled.

DET activities will involve working with operational centers to maintain and support community codes relevant to ensemble modeling, as well as conducting extensive testing and evaluation of promising new capabilities and techniques that have been incorporated into these community codes. Including elements targeted for operational implementation will ensure the DET ensemble system does not lag behind the operational capabilities and will allow the DTC to contribute to operational upgrade decisions. In order to keep the testing and evaluation results relevant to operational upgrade decisions, the DET modules will be configured so they are able to replicate the algorithms used operationally at NCEP (and as DET is further developed, possibly at AFWA and other operational centers).



Example of probablistic product from ESRL/GSD 8-member WRF ensemble available to NOAA Hydrometeorology Testbed participants during HMT-West 2010 Operations (contributed by Isidora Jankov and Huiling Yuan).

Additionally, the DET has defined a process that allows the research community to provide input into the process and thus complete the research-to-operations bridge. This process includes engaging the WRF ensemble modeling working group (EMWG) to provide input in the DET planning activities as well as hosting technical workshops on focused subjects. Additional input will be infused into the DET through DTC collaborations with the USWRP funded HMT and HWT testbeds, as well as the HFIP program.

The DET has identified the following modules for inclusion in the this infrastructure:

1) Ensemble configuration; 2) Initial perturbations; 3) Model perturbations; 4) Statistical post-processing; 5) Product generation; and 6) Verification. An implementation plan for each module is being currently being developed by the DET team. Each section will include details of requirements for transfer to operations, needs to provide modularity, user requirements, and benchmarks. An integrated implementation plan will be compiled and released for comments by the WRF EMWG and others during a technical workshop planned for late summer. In the meantime, work on the initial perturbations and model perturbations modules has begun.

– Tara Jensen & Zoltan Toth

Publications Round-Up

Laidlaw, E. 2010: The Controversy Over Outdoor Warning Sirens, *Weatherwise*, 16-25.

Lazo, J. K., J. S. Rice, M. L. Hagenstad. 2010: Benefits of Investing in Weather Forecasting Research: An Application to Supercomputing, *Yuejiang Academic Journal*, **2**(1):18-39.

Lazo, J. K., D. M. Waldman, B. H. Morrow, and J. A. Thacher. 2010: Assessment of Household Evacuation Decision Making and the Benefits of Improved Hurricane Forecasting. *Weather and Forecasting*, **25**(1), 207-219.

Morss, R. E., J. K. Lazo, J. L. Demuth. 2010: Understanding the Use of Forecast Uncertainty Information in Decision Making: Results from a Survey. *Meteorological Applications* (in press).

Neiman, P. J., E. M. Sukovich, F. M. Ralph, and M. Hughes, 2009: A seven-year wind profiler-based climatology of the windward barrier jet along California's Sierra Nevada. *Mon. Wea. Rev.*, **138**, 1206-1233.

Schwartz, C. S., J. S. Kain, S. J. Weiss, M. Xue, D. R. Bright, F. Kong, K. W. Thomas, J. J. Levit, M. C. Coniglio, 2009: Next-day convection-allowing WRF model guidance: A second look at 2 vs. 4 km grid spacing. *Mon. Wea. Rev.*, **137**, 3351–3372.

Smith, B. L., S. E. Yuter, P. J. Neiman, and D. E. Kingsmill, 2010: Water Vapor Fluxes and Orographic Precipitation over Northern California Associated with a Landfalling Atmospheric River. *Mon. Wea. Rev.*, **138**(1), 74–100.

White, A., B., D. J. Gottas, A. F. Henkel, P. J. Neiman, F. M. Ralph, S. I. Gutman, 2009: Developing a performance measure for snow-level forecasts. *J. Hydrometeor.*, **11** (in press).

Recent & Upcoming Events

EMC/MMM/DTC Joint Hurricane Science Workshop
22-26 February 2010
http://www.dtcenter.org/

HFIP Ensemble Product Development Workshop
20-21 April 2010, NCAR Foothills Lab
http://www.ral.ucar.edu/jnt/tcmt/events/2010/hfip_ensemble_workshop/

11th Annual WRF Workshop
21-25 June 2010, NCAR Center Green, Boulder, CO
http://www.dtcenter.org/

GSI Community Tutorial
28-30 June 2010, NCAR Foothills Lab, Boulder, CO
http://www.dtcenter.org/

Summer WAS*IS
August 5-13, 2010, Boulder, CO
http://www.sip.ucar.edu/wasis/summer10/apply.jsp

Model Evaluation Tools (MET) Tutorial
Early August 2010, NCAR Foothills Lab, Boulder, CO

Awards & Recognition

NOAA Bronze Medal: Daniel J. Gottas, Seth I. Gutman, Paul J. Neiman, David R. Reynolds (NWS), and Allen B. White – *For innovative contributions to the development of the Coastal Atmospheric River Monitoring and Early Warning System.*

Testbeds at a Glance

Climate Testbed (CTB)
http://www.cpc.noaa.gov/products/ctb/

Developmental Testbed Center (DTC)
http://www.dtcenter.org/

Hazardous Weather Testbed (HWT)
http://www.nssl.noaa.gov/projects/hwt/

Hydrometeorology Testbed (HMT)
http://hmt.noaa.gov/

Joint Hurricane Testbed (JHT)
http://www.nhc.noaa.gov/jht/

Societal Impacts Program (SIP)
http://www.sip.ucar.edu/